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Pseudomorphic replacement of zoisite by Fe-rich epidote - An experimental study at 0.5 GPa/500 to 650 °C

A. Liebscher (1) and G. Franz (2)

(1) GFZ German Research Centre For Geosciences, Centre for CO_2 Storage, Potsdam, Germany (alieb@gfz-potsdam.de), (2) Fachgebiet Mineralogie-Petrologie, TU Berlin, Ackerstr. 71-76 D 13355 Berlin

Within the frame of an experimental study on the zoisite-epidote phase relations pseudomorphs of Fe-rich epidote after zoisite seed crystals have been observed. Natural zoisite crystals (xps = 0 with xps = Fe3+/(Fe3++Al-2); small amounts of V) of few to several 100 μm in size were placed together with about 40 mg of an oxide-hydroxide mixture and about 25 mg of a 1 m CaBr2 solution into Pt-capsules. The oxide-hydroxide mixture was prepared from SiO_2, Al2O_3, Fe2O_3 and Ca(OH)2 weighed in stoichiometric amounts of Fe-rich epidote with either xps = 0.6 or xps = 1 plus 10 wt% SiO_2 in excess to account for SiO_2 solubility at run conditions and to ensure quartz saturation. The bromine fluid was used to enhance reaction but has no influence on zoisite-epidote phase equilibria as bromine does not enter into the crystal structures. Oxygen fugacity was buffered by conventional double capsule technique with a solid state hematite-magnetite buffer, mixed in a ratio of 9:1. The inner Pt-capsules were placed into outer Au-capsules with about 200 mg hematite-magnetite mixture and 200 mg H_2O. Hydrothermal runs were then performed in conventional cold seal hydrothermal vessels with horizontally positioned autoclaves and water as the pressure medium. Run conditions were 0.5 GPa/500, 550, 600, and 650 °C with run durations of either 21 or 42 days. Run products were investigated by optical and scattering electron microscopy and by electron microprobe analyses. Zoisite seed crystals show partial to complete pseudomorphic replacement by Fe-rich epidote. Contacts between relic zoisite and replacing Fe-rich epidote are mostly sharp and follow crystallographic orientations. Optical inspection suggests that the pseudomorphic replacement predominantly initiates and migrates along the (100) cleavage of zoisite. Vanadium contents in replacing Fe-rich epidote are notably lower than in precursor zoisite and indicate that besides Al and Fe also V has been mobile during the pseudomorphic replacement. Overall, the data indicate a dissolution-precipitation process being responsible for the pseudomorphic replacement. However, no microporosity in replacing Fe-rich epidote, which could have served as transport channels for Fe, Al and V, has yet been observed in SEM analyses. Contrary to the sharp optical and compositional contacts between precursor zoisite and replacing Fe-rich epidote, some zoisite seed crystals show slightly iron enriched zones with diffuse contacts. One may speculate that these zones did not form via a dissolution-precipitation process but reflect diffusive Al-Fe exchange in zoisite.